CLAIMS

1. A toner comprising:

a thermoplastic resin;

a colorant;

a wax; and

a crystalline polymer,

wherein at least one of the following formulas (I) or (II) is satisfied:

$$Tg(W_T) < Tg(W_W) - 2 \quad \text{(I)}$$

$$Tg(CP_T) < Tg(CP_{CP}) - 2 \quad \text{(II)},$$

wherein $Tg(W_T)$ and $Tg(W_W)$ are the DSC endothermic peak temperatures in °C of the wax measured in the toner and the wax measured alone, respectively and $Tg(CP_T)$ and $Tg(CP_{CP})$ are the DSC endothermic peak temperatures in °C of the crystalline polymer measured in the toner and the crystalline polymer measured alone, respectively.

2. The toner of Claim 1, wherein each of the wax and the crystalline polymer has a maximum average particle diameter of not less than 0.5 μm in a major axis diameter and not greater than 1/3 of a maximum particle diameter of the toner.

3. The toner of Claim 1, wherein the crystalline polymer is present in an amount of 1 to 50 parts by weight based on 100

parts by weight of the thermoplastic resin.

4. The toner of Claim 1, wherein the crystalline polymer has a DSC endothermic peak temperature of from 80 to 150 ℃.

5. The toner of Claim 1, wherein the components of the crystalline polymer soluble in ortho-dichlorobenzene have a weight-average molecular weight (Mw) of from 1,000 to 30,000 and a number-average molecular weight (Mn) of from 500 to 6,000 by gel permeation chromatography, and wherein a ratio Mw/Mn is from 2 to 8.

6. The toner of Claim 1, wherein the components of the crystalline polymer soluble in ortho-dichlorobenzene have a weight-average molecular weight (Mw) of from 1,000 to 6,500 and a number-average molecular weight (Mn) of from 500 to 2,000 by gel permeation chromatography, and wherein a ratio Mw/Mn is from 2 to 5.

7. The toner of Claim 1, wherein the crystalline polymer has an acid value of from 20 to 45 mg KOH/g.

8. The toner of Claim 1, wherein the crystalline polymer has a hydroxyl value of from 5 to 50 mg KOH/g.

9. The toner of Claim 1, wherein a CuKα X-ray diffraction spectrum of the crystalline polymer comprises a plurality of

diffraction peaks, and wherein the diffraction peaks are observed at Bragg (2θ) angles of at least 19 to 20°, 21 to 22°, 23 to 25° and 29 to 31° wherein said angles may vary by ±0.2°.

10. The toner of Claim 1, wherein the crystalline polymer is a crystalline polyester resin having the following formula:

$$[-O-CO-CR_1=CR_2-CO-O-(CH_2)_n-]_m$$

wherein R_1 and R_2 independently represent a hydrocarbon group, and n and m are integers.

11. The toner of Claim 10, wherein the crystalline polyester resin comprises polymerized units of:

a diol compound having 2 to 6 carbon atoms; and

at least one member selected from the group consisting of maleic acid, fumaric acid, succinic acid and compounds thereof.

12. The toner of Claim 11, wherein the crystalline polymer comprises at least one polymerized diol compound selected from the group consisting of 1,4-butanediol, 1,6-hexanediol and compounds thereof.

13. The toner of Claim 1, wherein the thermoplastic resin has a glass transition temperature of from 30 to 80 ℃.

14. The toner of Claim 1, wherein the thermoplastic resin has a weight-average molecular weight of from 2,000 to 9,000.

15. The toner of Claim 1, wherein the thermoplastic resin is at least one member selected from the group consisting of a polyester resin, a polyol resin, a polystyrene resin and a polystyrene-acrylic copolymer resin.

16. The toner of Claim 1, wherein the wax has a melting point of from 70 to 125 ℃.

17. The toner of Claim 1, wherein the wax is at least one member selected from the group consisting of carnauba wax, a polyethylene wax and a synthetic ester wax.

18. The toner of Claim 1, further comprising at least one of an inorganic particulate material or a particulate resin.

19. A method of producing the toner according to Claim 1, comprising:

dissolving or dispersing a toner composition comprising the thermoplastic resin, the colorant, the wax and the crystalline polymer in an organic solvent,

heating to prepare a toner liquid solution or a toner dispersion liquid;

removing the organic solvent from the toner liquid solution or toner dispersion liquid to prepare a toner material; and

pulverizing and optionally classifying the toner material.

20. A toner produced by the method of claim 19.

21. The method according to Claim 19, further comprising:

dispersing each of the wax and the crystalline polymer in a liquid before dissolving or dispersing the toner composition, wherein the wax and crystalline polymer have a maximum average particle diameter not less than 0.5 μm in a major axis diameter and not greater than 1/3 of a maximum particle diameter of the toner.

22. A method of producing the toner according to Claim 1, comprising:

mixing and kneading a toner composition comprising the thermoplastic resin, the colorant, the wax and the crystalline polymer,

heating with a kneader to prepare a toner material; and

pulverizing and optionally classifying the toner material.

23. A toner produced by the method of claim 22.

24. A method of producing the toner according to Claim 1, comprising:

directly polymerizing a toner composition comprising a polymerizable monomer, the colorant, the wax and the crystalline polymer in an aqueous phase.

25. A toner produced by the method of claim 24.

26. A method of producing the toner according to Claim 1, comprising:

subjecting a toner composition comprising a prepolymer including an isocyanate group, the colorant, the wax and the crystalline polymer and one or more amines to a polyaddition reaction to at least elongate or crosslink the prepolymer.

27. A toner produced by the method of claim 25.

28. The method according to Claim 24, further comprising:

dispersing each of the wax and the crystalline polymer in a liquid before directly polymerizing the toner composition,

wherein the wax and crystalline polymer have a maximum average particle diameter not less than 0.5 μm in a major axis diameter and not greater than 1/3 of a maximum particle diameter of the toner.

29. The method according to Claim 26, further comprising:

dispersing each of the wax and the crystalline polymer in a liquid before subjecting the toner composition to the polyaddition reaction,

wherein the wax and crystalline polymer have a maximum average particle diameter not less than 0.5 μm in a major axis diameter and not greater than 1/3 of a maximum particle diameter of the toner.

30. A one-component developer comprising the toner according to Claim 1.

31. A toner container comprising the one-component developer according to Claim 30.

32. A two-component developer comprising a carrier and the toner according to Claim 1.

33. A toner container comprising the two-component developer according to Claim 32.

34. An image forming method comprising:

developing an electrostatic latent image formed on an image bearer with the one-component developer according to Claim 30 to form a toner image thereon;

transferring the toner image onto an image support medium; and

fixing the toner image on the image support medium with a fixer having at least a roller or a belt upon application of heat and pressure to the toner image.

35. An image forming method comprising:

developing an electrostatic latent image formed on an image bearer with the two-component developer according to Claim 32 to form a toner image thereon;

transferring the toner image onto an image support medium; and

fixing the toner image on the image support medium with a fixer having at least a roller or a belt upon application of heat and pressure to the toner image.

36. An image forming apparatus comprising:

an image developer configured to develop an electrostatic latent image formed on an image bearer with the one-component developer according to Claim 30 to form a toner image thereon;

a transferer configured to transfer the toner image onto an image support medium; and

a fixer configured to fix the toner image on the image support medium upon application of heat and pressure with at least a roller or a belt.

37. An image forming apparatus comprising:

an image developer configured to develop an electrostatic latent image formed on an image bearer with the two-component developer according to Claim 32 to form a toner image thereon;

a transferer configured to transfer the toner image onto an image support medium; and

a fixer configured to fix the toner image on the image support medium upon application of heat and pressure with at least a roller or a belt.

38. A detachable process cartridge with an image forming

apparatus comprising:

a photodetector; and

a member selected from the group consisting of a charger, an image developer comprising the developer according to Claim 30 and a cleaner.

39. A detachable process cartridge with an image forming apparatus comprising:

a photodetector;

the developer according to Claim 30; and

at least one member selected from the group consisting of a charger and an image developer.

40. A detachable process cartridge with an image forming apparatus comprising;

a photoreceptor; and

at least one member selected from the group consisting of a charger, an image developer comprising the developer according to Claim 32 and a cleaner.

41. A detachable process cartridge with an image forming apparatus comprising;

a photoreceptor;

the developer according to Claim 32; and

at least one member selected from the group consisting of a charger and an image developer.